

DRAWINGS ATTACHED

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(54) A PREAMPLIFIER FOR A CAPACITIVE TRANSDUCER

(71) We, AKUSTISCHE U. KINO-GERATE
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 pany, of Nobilegasse 50, 1150 Vienna XV,
 Austria, do hereby declare the invention, for
 which we pray that a patent may be granted
 to us, and the method by which it is to be
 performed, to be particularly described in and
 by the following statement:—

This invention relates to a transis-
 torized preamplifier assembly for a capacitive
 transducer.

The advantage afforded by transistorized
 preamplifiers in general compared to valve
 amplifiers resides mainly in the low power
 input which they require. The low voltages
 which are generally employed with transistors
 enable the preamplifier to be operated with
 a voltage applied from the succeeding main
 amplifier so there is no need for a mains-oper-
 ated power supply such as is used for valve
 amplifiers. The fact that the filament circuit
 is eliminated and the supply voltage required
 is low enables the use of simplified supply
 circuitry whereby, e.g., in arrangements in
 which a two-wire cable is used between the
 preamplifier and main amplifier the d.c. volt-
 age required to operate the preamplifier is
 supplied directly from the main amplifier in
 a phantom circuit which includes the two
 wires of the cable and the shield thereof.
 If a three-wire cable is used, the third wire
 of the cable rather than the shield can be
 used as a return conductor.

In such an arrangement including a capaci-
 tive transducer, the transducer can be oper-
 ated if a cable connection is established be-
 tween the microphone and the subsequent
 main amplifier, just as in the case of a
 dynamic microphone. Although the supply
 voltage is applied through the two sound
 wires, a dynamic microphone can be directly
 connected to the same plug receptacle with-
 out disturbing the function thereof. When
 the previously usual preamplifiers for con-
 denser microphones were used, the polarity

of the supply voltage had to be checked be-
 fore these preamplifiers were connected to the
 main amplifiers. A check was required in each
 case to determine whether the supply voltage
 applied from the main amplifier to the pre-
 amplifier had the correct polarity. For this
 purpose, a studio technician, who may have
 to attend to a large number of amplifiers,
 must be exactly aware of the circuit arrange-
 ment of each amplifier and any error which
 may occur may result in a destruction of
 parts of the preamplifier. The polarity can-
 not be standardized because the use of dif-
 ferent types of transistors (n-p-n, p-n-p) re-
 quires the use of amplifiers having a grounded
 negative terminal and of amplifiers having a
 grounded positive terminal.

For this reason, preamplifiers of two
 polarity types must also be available so that
 an error may result in a connection between
 two amplifiers which do not match.

A further drawback of known arrangements
 is that the voltage available for the preampli-
 fier is limited by the magnitude of the supply
 voltage. This is especially important when
 the preamplifier is associated with a condenser
 microphone requiring a transducer-polarizing
 voltage which is a multiple of the voltage re-
 quired for the operation of the preamplifier
 and which must be supplied by a separate
 source in known arrangements. This involves
 further complications.

According to the present invention, there
 is provided a transistorized preamplifier
 assembly for a capacitive transducer, including
 a voltage converter for connection to a d.c.
 voltage supply, which converter is connected
 to deliver to the transistorized preamplifier
 and to the capacitive transducer respective
 d.c. operating voltages having a polarity in-
 dependent of the polarity of the d.c. voltage
 supply, the voltage converter including an
 oscillator circuit in which two transistors of
 opposite conductivity type are connected in
 parallel and being capable of providing oper-

ating voltages having a magnitude different from that of the d.c. voltage supply.

5 By employing the present invention a pre-amplifier can be arranged so that it is independent of the polarity of the supply voltage without need for changes in the circuitry of the amplifier proper. This fact results in advantages regarding the reliability of operation, the noise level and the circuit expenditure, the desired independence being ensured by the provision of the d.c. voltage to d.c. voltage converter.

10 The transistors of the oscillator circuit of the d.c. converter should be as similar as possible in their transmitting properties and frequency response and particularly as regards the breakthrough voltage so that a satisfactory function of the d.c. voltage converter is ensured regardless of the polarity of its supply voltage. Depending on the polarity of the supply voltage, one or other of the transistors of the oscillator circuit will conduct. In one form of the invention an inductive element of the oscillator circuit is constituted by the secondary winding of a transformer which has a centre tap, and one end of said winding and the centre tap thereof are connected to the inputs of mutually independent rectifier circuits.

15 Because the polarity is incorrect for the transistor which is inoperative, such transistor will be virtually blocked and carry only a very small current. This transistor is virtually no load on the other transistor and does not substantially influence the oscillation behaviour thereof.

20 The preamplifier may suitably include a field effect transistor.

25 Assuming an efficiency of 25%, a usual supply voltage of 12 volts for a field effect transistor amplifier and a current consumption of 0.5 milliamperes, the total current input of the circuit will be about 2 milliamperes. The main amplifier is usually capable of supplying direct current up to 10 milliamperes so that a satisfactory operation is ensured when the assembly is supplied with power from the main amplifier via a phantom circuit.

30 The invention will now be explained more fully with reference to the single figure of the drawing, which represents a basic circuit diagram of a preamplifier assembly embodying the invention.

35 The preamplifier proper is represented by that part of the circuit arrangement which is within the dashed lines. A condenser microphone M comprises two electrodes, one of which is connected to earth and the other of which is connected firstly by a resistor R₁ to a polarizing voltage source and secondly, for alternating current, by the capacitor C₁ to the gate electrode of a field effect transistor T₁. The latter operates as an impedance

transformer and has a low-resistance output, which is connected to the primary winding of a transformer T₂, the secondary winding of which has a centre tap. In cable wires a, b leading from the preamplifier to the main amplifier, the supply current I₀ flows in the same direction to the preamplifier, in which the centre tap of the secondary winding of the transformer T₂ is connected to the terminal $\pm U_0$.

40 A d.c. voltage converter of the assembly is fed through the latter terminal and consists essentially of an oscillator circuit comprising a transformer U having a secondary winding connected in parallel with a capacitor C₂, an n-p-n transistor T₃ and a p-n-p transistor T₄ in parallel, a feedback capacitor C₃, and a resistor R for applying the base voltage to the transistors. These parts of the circuit are shown on the left of the dash-dot line. On the right of that line, two rectifier circuits G₁, G₂ are shown, and these consist of half-wave rectifiers as usual. Special means for filtering the rectified voltages are neither required nor provided because the frequency of the converter may be so high, e.g., 1 Megacycle, that the filtering afforded by resistor R₂ and the capacitance of the capsule of the condenser microphone M, or by resistor R₃ and capacitor C₃, is sufficient.

45 In the practical dimensioning of the d.c. voltage converter, care should be taken that the breakthrough voltages of the diode paths of the two transistors T₁, T₂ cannot be exceeded. This requirement requires primarily a suitable selection of the two transistors. Because the operating voltage is generally 12 volts, it will be suitable to select transistors having a breakdown voltage which is reliably at least twice that value.

50 The polarities of the supply voltage for the pre-amplifier and of the polarizing voltage are determined only by the forward direction of the rectifier diodes D₁, D₂. This affords the advantage that the requirement for in-phase operation, i.e., that a positive acoustic impulse on the diaphragm of the condenser microphone M will result in a positive electric pulse, will always be met regardless of the polarity of the supply voltage.

55 Because only small components are used, the pre-amplifier and the voltage converter may be combined in a unit, which is supplied with power by a phantom circuit including the sound wires and the cable shield. The pre-amplifier, voltage converter and condenser microphone may be combined in a unit, e.g., by accommodating the preamplifier and voltage converter in the microphone housing. Such a condenser microphone unit would have properties similar to those of a low-resistance dynamic microphone.

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WHAT WE CLAIM IS:—

1. A transistorized preamplifier assembly for a capacitive transducer, including a voltage converter for connection to a d.c. voltage supply, which converter is connected to deliver to the transistorized preamplifier and to the capacitive transducer respective d.c. operating voltages having a polarity independent of the polarity of the d.c. voltage supply, the voltage converter including an oscillator circuit in which two transistors of opposite conductivity type are connected in parallel and being capable of providing operating voltages having a magnitude different from that of the d.c. voltage supply.
2. An assembly according to claim 1, in which the voltage converter includes a transformer receiving the output of the oscillator circuit and having a centre-tapped secondary winding, the centre tap of the secondary winding being connected to a rectifier circuit arranged to deliver the respective d.c. operating voltage to the preamplifier and one end

of the secondary winding being connected to another rectifier circuit arranged to deliver the respective d.c. operating voltage to the transducer. 25

3. An assembly according to claim 1 or 2, in which the preamplifier includes a field effect transistor. 30

4. A transistorized preamplifier assembly substantially as hereinbefore described with reference to and as illustrated in, the accompanying drawing.

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